GRIFFITH - Mineral Resources of Southern Ohio.

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Mining

REPORT

OF THE

MINERAL RESOURCES, &c.,

ON THE LINE OF THE

Gallipolis, McArthur

—AND—

Columbus Rail Road,

WITH MAPS.

—BY—

WM. GRIFFITH, JUN'R,

Gallipolis, O.

APRIL, A. D. 1872.

MAP

Showing the Local and Continental CONNECTIONS FORMED BY THE GALLIPOLIS McARTHUR AND COLUMBUS RAILROAD,

SPECIALLY ITS LINK WITH THE, CHESAPEAKE AND OHIO AND FARMERS AND MINERS RAILROADS FOR ATLANTIC, WEST AND NORTHWEST TRAFFIC.

William Griffith, Jr.

Strobridge & Co. Lith. Cin.ti

MICHIGAN

LAKE ERIE

MAURY'S EQUIDISTANT LINE FOR NEW YORK AND NORFOLK, VA.

INDIANA

OHIO

KENTUCKY

WEST VIRGINIA

Lima
TOLEDO
Maumee City
Perrysburg
SANDUSKY
CLEVELAND
Elyria
Fremont
Clyde
Monroeville
Defiance
FORT WAYNE
Huntington
Van Wert
Delphus
Ottawa
Finley
Carey
Upper Sandusky
Bucyrus
Crestline
Lima
Galion
Mansfield
Shelby
Ashland
Akron
Ravenna
Wooster
Canton
Kenton
Marion
Londonville
New Philadelphia
Mt. Vernon
Bellefontaine
Delaware
Coshocton
Sidney
UNION CITY
Muncie
Winchester
Greenville
Piqua
URBANA
Milford
Woodstock
Newark
Cambridge
Springfield
London
COLUMBUS
Zanesville
New Paris
Cambridge City
Richmond
Centreville
Eaten
DAYTON
Somerset
New Lexington
Xenia
Lancaster
Connersville
Washington
CIRCLEVILLE
LOGAN
Straitsville
Nelsonville
Union
Marrietta
Hamilton
Morrow
Adelphi
Athens
Hope
Zaleski
Parkersburg
Blanchester
Chillicothe
Loveland
Hillsborough
McArthur
Dundas
Vinton
Eagle
Hocking Port
CINCINNATI
Hamden
Lincoln
Laurobe
Wilkesville
Pomeroy
Lawrenceburg
Jackson
Buckeye
Keystone
Ewington
Vinton
Limestone
Porter
Evergreen
Madison
Oakhill
Portsmouth
GALLIPOLIS
Pt. Pleasant
Maysville
Greenup
Ironton
Hurricane
HUNTINGTON
CHARLESTON
Falls of Kanawha

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TO THE

PRESIDENT AND DIRECTORS

OF THE

Gallipolis, McArthur & Columbus R. R.

GENTLEMEN:—

I have, conformable with your instructions, examined the mineral resources on the line of your Railroad, and that you may the more clearly understand the result of my researches, I have, with care, prepared three maps, two of which illustrate the geological strata at various points on the line of your road, with full explanations for all the cross sections, &c. The other one will delineate the western extent of the Ohio Appalachian coalfield, through which your road will traverse for its whole length; at the same time showing its local and continental connections with the most important Railroad systems of the United States for Atlantic, West and Northwest traffic.

The mineral wealth laying contiguous to your road consists of iron ores of the various kinds usually found in the coal measures, bituminous, cannel and splint coals, fire and pipe clay, limestone, variegated marble, buhr rock and salt.

IRON ORE.

There are twelve well defined iron ore strata in the coal measures of your district, and like all others of those measures, are carbonates of protoxide of iron, Fe O. CO 2., and when pure, contain 48,275 per cent. metallic iron.

This iron ore after long exposure to atmospheric influences becomes partially decomposed, and forms, in some instances, a hydrated susquioxide of iron 2 $Fe_2 O_3$ 3 H O, containing, when pure, 59,89 per ct. metallic iron, and 14,40 per ct. water, and is generally known then by the name of Brown Haematite, locally called limestone ore.

The crop iron ore laying upon the ferriferous limestone and known in this region by the name of limestone ore, is an ore of this variety.

Your Railroad will intersect the twelve different veins of iron ore partially decomposed into limonite, or limestone ore, on their crops, in this region, and will run for a distance of not less than twenty miles, within a few feet of the great limestone iron ore vein; or from Sec. 20, Wilkesville township, Vinton county, to Dr. Wolf's speed farm, north of McArthur.

This remarkable deposit of iron ore, coal, limestone and fire clay, is persistant throughout the coal measures of your district,

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and on the land of Mr. Wm. Gold, Sec. 22, Elk township, Vinton county. The iron ore vein was when mined, nine feet thick, and considerably less than two acres yielded 10,880 tons, notwithstanding the primitive way it was mined. (*See page* 109, *Geological survey of Ohio*, 1870.)

This ore has been extensively mined on the land of Mr. C. B. Pilcher, Sec. 15, Elk township, Vinton county, and on the land of many others around and near McArthur.

This iron ore is mined by the Lincoln, Buckeye, Latrobe, Hamden, Vinton, Big Sand, Eagle and Keystone furnaces. Large masses of this valuable iron ore can be seen on the furnace banks of the Buckeye and Keystone furnaces. That proves that the vein they were taken from must be not less than from four to five feet thick. All of those furnaces at present in blast, mine large quantities of this ore, probably nine tenths of all they reduce.

On Raccoon, and within a few feet of your Railroad, this iron ore is found from six inches to five feet thick, and of a very superior quality, as Prof. Wormley's analysis in the Geological Survey of Ohio, 1870, will show—pages 439, 440, 441.

The best brands of pig iron made in the Hanging Rock region, are all made from this iron ore. There are but a few of the sixty-five blast furnaces in the region, when in blast, that have used any other iron ore.

The next iron ore vein of importance is the one that comes near the Simmons, or New Castle coal vein. This undeveloped vein of block ore is found on the Eagle furnace lands, and on the top of the hills, north and south of this furnace. At one place on this furnace land, it is reported by those that mined the ore, to be full seven feet thick. This would, of course, be an unusual thickness, but it can be seen from eighteen to thirty inches thick, which, indeed, is a very valuable vein.

Brown Haematites, or limestone ore as it is locally called, is found in great abundance on the western sections of Swan township, Vinton county, for instance, on the land of Mr. S. P. Deaver; indeed, more or less on all land in the township. Large quantities are also to be found in Benton township, Hocking county, of a very superior quality.

Those ores are no doubt the remains of the decomposed veins of carbonates laying near the Putnam Hill limestone.

I have no hesitancy in saying that an aggregate of from five to seven feet of iron ore, including the Limestone vein will be found in the coal measures of this District of Southern Ohio.

Let us estimate this iron ore at six feet uniform thickness, and an average specific gravity for both hydrates and carbonates in round numbers, we will say 3, then say the ore will only yield the very low percentage of 33.3 per ct., or three tons of ore to the ton of pig, you will then have the following:

4840 yards in an acre of land;
2 yards thickness of iron ore;
9680 amount in yards on an acre;
2.25 weight in tons of a yard of ore—sp'gr 3.000;
3–21.780 total tuns of ore on an acre of land;
7260 tons of pig iron to an acre of land.

The block iron ores of this region are as yet but partially developed, owing to the prejudice furnace men have to them. However, when the preparing and reducing of them will be understood, as it is in other coal fields, yielding this valuable auxilliary to national wealth and progress, this prejudice will find a new home in (to the superficial observer) a more prolific iron ore field and virgin forests, with the small and costly charcoal furnace and its homeopathic productions, far away from the beauties and benefits of civilization. Then will science and enterprise reap its rich reward in the emolument it will well deserve for the reduction and conversion of this buried and undeveloped source of untold millions of wealth.

COAL.

Of coal, you have some sixteen veins, but at present you have only nine that are as yet developed and their thickness known. They are the following: (See Map No. 1.)

	ft. in	ft. in.
No. 1, Jackson shaft coal,	4 0 to	4 6
" 2, Anthony coal	3 0 to	3 6
" 3, Thompson coal,	undeveloped.	
" 3, Jackson hill coal,	2 6 to	2 6
" 5, (coal No. 10) and No. 6, or Flint Ridge coal,	undeveloped.	
" 7, Hawk Splint, developed by boring,	11 0 to	11 0
" 8, New Lexington coal,	2 6 to	2 6
" 9, Limestone vein,	6 0 to	7 0
" 10, New Castle coal, (or Simmons)	4 0 to	6 0
" 11, Norris coal,	undeveloped.	
" 12, Sheridan coal, (or Lawler)	4 0 to	6 0
" 13, Keystone coal, (or Stallsmith)	4 0 to	4 0
" 14, 15, 16, Hatcher and Wilkesville veins,	undeveloped.	
Total coal, in thickness,	41 0 to	47 0

From Gallipolis to Logan your Railroad will, in reality, intersect all the coal veins cropping on the Ohio Appalachian coal field.

You will reach the best, and probably the most profitable working coal vein above water level, on Sec. 20, Wilkesville township, Vinton county. There you will strike the great limestone vein, No. 9, and will run along side of her for a distance of not less than twenty miles.

Above this vein you have the Simmons vein, the Lawler vein, and the Keystone vein, and four other veins that are not properly developed, still are known to exist above the limestone vein where the hills are high enough to carry them. (*See Cross Section on Raccoon. Map No. 2.*)

This will give you from eighteen to twenty-three feet of coal above water level, that will yield from 29,000 to 37,000 tons, or in other words, from 812,000 to 1,036,000 bushels of coal to the acre.

Those figures will only include the amount of coal in the four veins, as I said before—*the Limestone*, *the Simmons*, *the Lawlor* and *the Keystone* veins.

The other four veins of coal above water level are only partially developed. I shall therefore not include their thickness.

The coal veins that will be found below water level on Raccoon, and that are at present well defined are, the Jackson shaft

coal, the Anthony coal, the Jackson Hill coal, the Hawk, or Raccoon splint coal, and the coal vein found in the bed of the creek on Sec. 27, Wilkesville township, Vinton county, that I say is the New Lexington vein of unknown thickness, for the water in the creek interfered with our operations in getting correct data, and only two feet six inches of the vein could be seen.

The aggregate thickness of coal below water level, and at present developed at this point on Raccoon and elsewhere in this region, will equal from twenty-three (23) to twenty-four (24) feet thick, and will yield from thirty-seven (37) to thirty-eight (38) thousand tons of coal, or from 1,036,000 bushels to 1,064,000 bushels of coal to the acre.

This again, will not, of course, include the Thompson coal, the No. 10 coal of the State Geological survey, nor the Flint Ridge coal, as those coal veins are as yet undeveloped in this district, as shown on Geological Cross Section, Map No. 1.

The Hawk, or Raccoon splint vein, and the New Lexington veins, are the only two veins enumerated in my estimate of thickness and quantity per acre of coal, that is not at present mined in the district, but they are fully developed, for on the Hawkins farm on Raccoon, the Hawk splint coal was bored through and the exact thickness ascertained in sinking a salt well. (See Map No. 2.)

The New Lexington vein that I have only put at two feet six inches thick, may be, and no doubt is, much thicker.

Northwest of McArthur, the lower coal veins found around and mined at and near Jackson, can be seen in the bottoms of the creek; for instance, Dr. Wolf's celebrated vein of coal will be found, I have no doubt to be identical with one of the Jackson veins.

This vein of coal, as the State Geological survey reports, (*Page* 106,) will be an invaluable coal for the reduction of the vast amount of iron ores to be found bordering your Railroad from Gallipolis to Logan.

But the coal veins worked at McArthur are the intervening veins, Nos. 5, 6, 7 and 8; they are much thicker than those mined at Jackson. No coal veins are mined near McArthur of any importance, less than four feet thick—some eight feet, but generally from five to seven feet veins, are the thickness mostly mined, and the coal, as is the case at all times in this region of the strata, a very superior quality. Fig: K. L. N. & P. of Map No. 1.

Between McArthur and Logan there are several coal mines, and only require a Railroad to fully develope them.

LIME STONE.

Of this you have inexhaustible quantities of the various kinds. The Putnam Hill, near McArthur, the Ferriferous skirting your road for twenty miles, the Sandy and the Fossiliferous between Hawks and Gallipolis, in sufficient quantities for building, fluxing, agricultural, and other purposes.

VARIEGATED MARBLE.

I have had quarried, samples, on the line of the Gallipolis,

McArthur and Columbus Railroad, of this beautiful rock, and sent to be polished at a number of marble works in Cincinnati and Eastern cities. I have also had some specimens polished at the marble works of the firm of Messrs. Miles, Reeves & Kerr, of Gallipolis. All concur in pronouncing the rock a superior class of variegated marble, very rare in its color, shade and texture, of inestimable value for table tops, chimney pieces, and all such work.

I have also examined a tombstone in the graveyard at McArthur, made from a fossiliferous limestone, of a loose, sandy texture, nothing in quality, color, shade or texture, like the one I have had polished and tested at the above named marble works.

PIPE AND FIRE CLAY.

You have, on the line of your Railroad, in untold quantities, good fire clay, underlaying and in close proximity to your coal veins. Large deposits are to be found near Mr. John Frezee's, and several other points between Gallipolis and McArthur.

Northwest of McArthur, on what is called the Potter's Ridge, there are, at present, quite a number of establishments in full operation, making pottery, and only need a Railroad to increase its production a hundred fold.

All the fire brick that will be needed for the construction and keeping in repair of the vast number of blast furnaces, Rolling mills and other metallurgical establishments, that will, in a short time, be located upon your road, can be made here for one-half the price fire brick could be possibly brought from any other fire brick producing localities.

SALT.

This valuable product was produced here years ago, and its evaporation only discontinued from the want of a cheap fuel: (*wood having formerly been used.*) With the Railroad, those flowing wells that to-day are allowed to run and waste into the creeks, will be turned into the salt pans to be evaporated by means of a cheaper fuel, in the form of small or slack coal, thereby enhancing for the land owner the value of his land; giving remunerating employment to hundreds, freight to your Railroad, and increased prosperity to the whole community.

BUHR STONE.

Near McArthur, and on Dr. Wolf's and other land, this rock is found in large quantities. At one time a considerable amount of business was done in the quarrying and preparing of this valuable rock for flouring mills.

Mr. Hulbert, of McArthur, who some years ago carried on quite an extensive business in the production of mill stones from this rock, "*says*," that in many instances, millers preferred them to French mill stones, and that with Railroad facilities, Raccoon buhrstones will again be able to compete successfully with the foreign mill stones.

RECAPITULATION.

The natural advantages offered from masters on the line of your Railroad, consists of cheap and a very superior quality of coal, iron ore, limestone and fire clay, in abundance. A densely populated farming community, anxious for public improvements, a region teeming with the best of citizens from one end of the line to the other, for the land from Gallipolis to Logan is as rich an agricultural district as such mineral lands can be made, and is in a high state of cultivation, producing all the necessaries of life, that will be sold to miners, furnace men, rolling mill men, and other operatives, at a very low price.

The question then to be solved is, will it compare with other iron producing regions of the United States? The experience of iron masters in Europe, proves that to make iron cheap it must be made in close proximity to cheap fuel. *In Scotland, Staffordshire* and *South Wales*, and other iron districts in coal fields, have prospered, for the simple reason that they have cheap fuel, together with prolific iron ores interspersed in their coal strata. (*All coal fields have not paying iron ore stratas in them*) such as yours have.

The Cleveland district of the Northeast of England, is in close proximity to the North of England coal field, and the (*oolitic*) or (*fossiliferous*) iron stone of the *Lias* formation South.

The iron works on the Northwest coast of England are well supplied with iron ore of a superior quality, but are not as well off for cheap and good fuel, therefore can not produce their superior iron for anything like in price that other English regions can.

In fact, no iron works have prospered in Great Britain but such as are in the coal fields, or have cheap fuels, since the successful introduction of mineral fuel in the reduction of iron by *Dud Dudley*, or rather by Abraham Darby, in 1730.

All the iron works that formerly existed in the Wealds of Surrey, Sussex and Kent, (*and more than one-half the English iron works were located here at one time,*) had to be removed to the coal fields after the charcoal had been used up, which, of course, was a great loss to the iron master of that district in those days.

(*History repeats itself.*) The same will be the case here when the charcoal is all used up. All furnaces outside of the different coal fields will have to stop incurring a dead loss to the owners of the cash value of their improvements.

On the continent of Europe, all the large and more successful iron works are located in the coal fields; for instance, "the Company Cockerill, at Sering, in *Belgium*, Fred. Krupps at Essen, *Rhenish*, *Prussia*, and those mammoth works of Mons. Schneider, at Creusot, *France*.

All iron works in this country, outside of the coal fields, have their profits eaten up by freight on the raw material, and could not possibly exist without a tariff.

Only think, for a moment, a furnace built outside of the raw material, have to pay freight on not less than from six to seven tons of material, and then pay freight to market.

Whereas, a furnace built in the midst of the raw material, have only to pay freight to market, which is only on one ton.

Shrewd iron masters will be prepared for the emergency, whatever turn the tariff may take, and profit by the experience of their predecessors, locate themselves at once where they can have the raw material necessary for the production of first-class iron, at the lowest rates, and the least Railroad freight to mines—freight to market is beyond control.

E. S. Baker, Esq., of Philadelphia, *Penna.*, Treasurer of the Eastern Iron Masters' Association, gives the following as the cost of making a ton of pig iron in *Penna.*, for the year 1871:

Cost of iron ore to the ton of pig iron,	$12 67
" " coal " " "	8 59
" " limestone " " "	2 08
" " labor, " " "	3 54
Contingencies, interests, &c.,	2 77
	$29 65

I will compare this estimate with the price a ton of pig iron can be produced for, on your Railroad, and to make it as fair, and liberal, as I can. I will put the price of labor and contingencies the same as it is in Mr Baker's estimate:

3 tons of coal at $1 25 per ton,	$3 75
Royalties 05 " "	15
3 tons of iron ore 2 50 " "	7 50
Royalties 05 " "	15
1 ton of limestone 1 00 " "	1 00
Royalties 05 " "	05
Labor,	3 54
Contingencies, interests, &c.,	2 77
	$18 91

This estimate will give an advantage in favor of the Hanging Rock coal region of ten dollars and seventy-four cents in the making of a ton of pig iron, notwithstanding the high figures for labor, &c.

Nothing will prove more conclusive to the practical mind, the high price I have put in my estimate on the cost of coal, iron ore, and limestone, than a review of the limestone, veins of coal, iron ore, &c., as shown on Map No. 1, of Geological Cross Sections: Fig. U. N. M. Q. & J.

In the working of this strata, the raw material used in the making of a ton of pig iron is mined all in one working, and will yield as follows to the acre.

Say only 6 feet of coal,	9,500 tons.
" " 2 feet of limestone,	6,500 "
" " 1 foot of iron ore,	3,630 "
" 2 to 3 feet of fire clay,	6,000 "

Or, 266,000 bushels of coal, 130,000 bushels of lime, 1,210 tons of pig iron, and 1,500,000 fire brick.

The land owners will receive in Royalties, for the minerals on one acre of this land, for this vein, as follows:

9,500 tons of coal,	5 cts. per ton,	- - -	$475 00
3,226 cubic yards limestone,	" " yard,	- - -	161 30
3,630 tons of iron ore,	" " ton,	- - -	181 50
4,000 cubic yards of fire clay,	" " yard,	- - -	200 00
Total value of one acre in Royalties,		- - -	$1,017 80

The reduction of the iron ores of this region with the mineral fuel found in such abundance on the land, is only a question of time, and that a very short time, too. I ought to say that I have made more than a hundred bushels of first-class coke from this coal; samples of which can be seen at the Diamond Mills, Gallipolis.

To-day there are only from six to seven blast furnaces in this region, out of about sixty-five in and out of blast, that reduce their iron with the bituminous coal of the region.

In 1845, Belgium had thirty-three (33) coke blast furnaces, producing 121,059 tons of pig iron and twenty-three (23) charcoal blast furnaces, producing 15,504 tons of pig iron. In 1864, Belgium had forty-six (46) coke blast furnaces, producing 444,330 tons of pig iron, and only six (6) charcoal blast furnaces producing 5,545 tons of pig iron.

In the United States the production of pig iron of the various kinds have been as follows:

Anthracite.	Bituminous Coal and Coke.	Charcoal.
1854, 339,435 tons.	64,485 tons.	342,298 tons.
1871, 875,000 "	050,000 "	375,000 "

This shows the increase in the production of the different kinds of pig iron produced in the United States for the last seventeen years to be as follows: Charcoal nine per cent. Anthracite two hundred and sixty per cent. Bituminous coal and coke pig iron one thousand two hundred per cent.

Years ago coke produced from bituminous coal proved itself to be the best and the most proper fuel for the reduction of iron in Europe, notwithstanding their having Anthracite coal in the Swansea Valley, South Wales, containing over 96 per ct. carbon.

Mr. Crane, of the Yniscedwin iron works, Glamorganshire, South Wales, would never have spent the money he did in experimenting with Anthracite coal in the blast furnace, could he have had bituminous coal as cheap as this refractory fuel.

Nor would Eastern iron masters spend the necessary extra cost for machinery, &c., for the reduction of their iron ore, with this almost incombustible fuel, could they have the more combustible coke, for the same price, at their furnace.

Coke furnaces of equal cubic contents, pressure, temperature, and volume of blast, consume fully twenty-five per cent. less fuel, and yield almost fifty per cent. more pig iron than Anthracite furnaces. The largest yield of the largest and best constructed Anthracite blast furnace in Eastern Pennsylvania will not equal four hundred tons of pig iron for any one week's production.

Whereas, coke furnaces of about equal cubic contents, and

blowed with less pressure of blast, will yield from six hundred to eight hundred tons of pig iron per week. I have known one coke blast furnace to produce in one week over eight hundred tons of pig iron. Does not this prove that *Coke* is the *King* of fuels for the reduction of iron?

I will here give Dr. Wormley's analysis of the iron ores, coal, limestone and fire clay, of this district:

CARBONATES.

	Sp'gr.	Silicious matter.	Carbonate of Iron.	Sesquioxide of Iron.	Alumina.	Oxide of Manganese	Carbonate of Lime.	Carb'nate of Magnesia.	Phosphoric Acid.	Sulphur.	Combined Water.	Phosphate of Lime.	Metallic Iron.
Hope Furnace - - -	3.317	18.17	64.70	9.18	0.60	1.40	4.60	1.97	0.11	0.10	"	0.24	37.18
Wm. Craig's - - - -	3.516	3.93	70.10	11.16	- - -	trace	4.10	6.17	0.42	0.03	1.77	"	42.00
Buckeye Block - -	4.872	31.56	34.01	13.58	2.60	0.45	9.25	1.40	0.89	0.12	1.24	"	42.29
" " - - -	3.375	8.84	55.99	13.91	0.30	0.55	4.70	2.38	0.53	3.33	3.25	"	25.91
Grey Limestone - -	3.245	23.36	48.44	13.16	0.80	0.25	4.90	0.81	0.06	0.16	3.33	"	36.77
Zeleski Furnace -	- - -	8.56	25.68	46.6	1.00	1.45	3.57	5.60	0.38	2.53	4.38	"	45.09

With regard to the values of those carbonates it will be better appreciated when it is understood that two-thirds of the iron produced in the various iron works of Great Britain are reduced from this class of iron ore, and there they contain as high as 1.42 per cent. phosphoric acid, and 1.56 per cent. sulphuric acid, and as high as 27 per cent. pure silica.

The Cleveland argillaceous iron ores of the Lias of Yorkshire, England, contain from a trace up to as high as 5.00 per cent. phosphoric acid, and from 23 to 24 per cent. silica. Yet over 1,500,000 tons of pig iron is reduced from them yearly.

HYDRATED SESQUIOXIDE.

	Sp'gr.	Combined Water.	Silicious matter.	Sesquioxide of Iron.	Alumina.	Oxide of Manganese	Carb. of Lime.	Carb. of Magnesia.	Phosphoric Acid.	Sulphur.	Metallic Iron.
Wm. Craig's - - - - -	2.814	7.50	6.49	83.74	0.70	trace	0.12	0.30	0.95	0.06	58.62
Rich Simms - - - - -	3.182	10.20	21.71	65.00	0.20	0.95	0.39	0.76	.00	trace	45.50
Buckeye Furnace - -	2.980	10.40	5.84	79.46	0.40	1.90	0.40	0.68	0.64	0.12	55.58
Four Samples - - -	2.868	11.90	1.62	72.61	0.40	1.05	9.75	1.59	0.46	0.14	50.83
Limestone ore - - - -	2.983	7.40	3.44	87.89	.00	0.10	trace	0.62	0.41	trace	61.52
Of the Crops - - - -	2.704	11.10	23.64	62.69	.00	0.09	trace	0.75	0.75	trace	43.88
Pat McAllister - - -	2.709	12.65	17.26	65.65	0.05	1.49	0.55	1.28	0.21	0.10	45.95
" - - - - - - -	2.307	8.90	22.16	60.86	.00	3.95	0.12	0.83	2.52	trace	42.60
" - - - - - - -	3.333	7.50	6.64	79.37	.00	1.75	2.95	0.56	0.91	.00	55.56
" fine block - - - -	3.018	7.75	10.04	78.74	0.30	1.75	.00	0.64	0.22	.00	55.12
" little fine block - -	2.287	11.69	13.08	72.43	.00	1.10	0.55	0.83	0.25	trace	50.70
" red block - - - - -	2.682	8.75	43.46	45.95	.00	0.50	0.20	0.50	0.97	trace	32.17
I. Anthony - - - - -	- - -	12.20	7.64	72.20	3.20	2.15	1.30	0.72	0.83	0.21	50.54

In the above analysis of the Hydrates, the phosphoric acid is quite an exception in one case only, the second one of Mr. McAllister's, 2.52 per cent. This will equal 1.10 per cent. phosphorus. All the samples are very free from sulphur. The silicious matter in one sample is also in excess.

The average amount of phosphoric acid in the other twelve will equal 0.55 per cent., or 0.24 per cent. phosphorus. English hydrates such as the Northamptonshire, contain, in some cases, 3.17 per cent. phosphoric acid, or more than 1.38 per cent. phosphorus, and as high as 21 per cent. silica, yet are reduced to advantage in admixture with other iron ores.

Borsig, of Prussia, makes good pneumatic steel from pig iron, reduced from iron ores containing more silica than this—*so it is reported*, but experienced iron and steel men know that good iron can only be reduced from good iron ore, and fuel, &c., that it is preposterous to say that steel can be made from anything but the best of material, for so long as no element can be found that has a greater affinity for sulphur and phosphorus in the presence of iron, than iron, it is idle to talk of eliminating either of those elements from the iron. It is also absurd to say that any *iron ore*, physics, &c., will make good steel from bad iron. With proper selection, [however,] iron ore will be found on your road that will fulfill all you require.

BITUMINOUS COALS.

	Sp'gr.	Moisture.	Ash.	Volatile Combustible Matter.	Fixed Carbon	Total.	Sulphur in Coal.	Sulphur in Coke.	Per c. of Sulphur in Coke.	Fixed gas per lb. in cubic feet.	Iron in Coal.
Anthony's Coal	1 239	5 25	1 50	29 75	63 50	100	0 98	0 37	0 57	3 00	- - - -
Webster's, Gallia Co.,	1 307	4 05	7 60	34 35	54 00	100	1 17	- -	- -	3 48	
" "	1 295	6.00	4 65	31 20	58 15	100	0 86	- -	- -	3 05	
" "	1 309	5 15	4 60	29 65	60 60	100	0 88	0 07	0 11	3 24	
Stephenson's, Jackson Co.,	1 281	8 70	1 50	28 30	61 50	100	0 57	0 43	0 68	2 67	0 102
Starr Furnace, " "	1 267	7 50	4 10	30 90	57 50	100	0 74	0 54	0 84	2 51	0 102
Jacob Sells', " "	1 298	8 50	2 35	32 20	56 95	100	0 91	0 07	0 11	3 44	0 133
" " " "	1 271	8 6	0 77	28 45	62 13	100	0 68	0 30	0 54	3 44	0 053

CANNEL COAL.

Gillard's, Jackson Co.,	1 276	4.30	6.25	37.70	51.75	100	1.25	- -	- -	3.05	
Jacob Sells', " "	1 292	6 40	5 20	38 40	50 00	100	1 27	- -	- -	3 [illegible]	

BITUMINOUS COALS.

	Sp'gr.	Moisture.	Ash.	Volatile Combustible Matter.	Fixed Carbon.	Total.	Sulphur.	Fixed gas per lb. in cubic feet.
Jackson Shaft coal	1.282	7.75	2.03	31.27	58.95	100	.53	
Jackson Hill coal	1.336	7.60	3.79	30.96	57.65	100	.49	
Enoch Canters' coal	1.298	8.55	5.20	25.25	61.00	100	.58	
Jackson Furnace coal	1.296	5.30	3.10	32.60	59.00	100	0.78	
Austin Thompson coal	1.262	6.80	1.50	30.80	60.90	100	1.08	
Jackson Shaft, H. F. Austin's	1.281	7.10	2.46	30.70	59.74	100	0.91	3.24
" " " "	1.317	7.40	4.31	35.00	53.29	100	2.73	- - -
Dr. Wolf's, Vinton Co., No. 1.	1.280	7.50	1.60	32.20	58.70	100	0.63	3.11
" " " No. 2.	1.305	5.40	6.20	28.20	60.20	100	0.66	3.11
McClintock's bottom vein	1.285	6.60	2.40	26.60	61.40	100	0.70	3.16
middle	1.295	6.80	3.50	30.80	58.90	100	0.96	3.32
top	1.319	8.40	8.00	25.60	58.00	100	0.82	2.83
Vinton Furnace bottom	1.321	4.60	10.60	29.00	55.80	100	1.30	2.92
" " middle	1.281	4.90	6.60	30.70	57.80	100	0.65	2.99
Vinton Co., R. P. Stokely's	1.277	3.90	3.05	35.90	57.15	100	2.00	2.92
" " J. Coils	1.348	5.10	9.25	27.50	58.15	100	1.11	2.75

The analysis of the coals of this district proves that we have plenty of first-class fuel [*with proper care and selection,*] for the reduction and conversion of our iron ores.

It is nonsense to suppose that *all* the veins in any coal field will produce coal fit for the reduction of iron. *On* the contrary, veins are selected for the reduction of the iron ores in the blast furnaces, and those that will not suit for this purpose are used in the conversion.

In Europe, all iron works in the coal fields have their particular veins of coal for the use of the blast furnaces, and others for the mills, &c.

In Scotland they have in the upper coal measures five veins of workable coal—*the Ell*, *the Pyot-shaw*, *the Main*, *the Humph*, and *the Splint*. This splint coal is the one preferred for the reduction of iron.

In Staffordshire, thick coal is used in the blast furnaces. In South Wales, they have all kinds of coal for the reduction of iron, but they would not think of using Banddelogg coal in the blast furnace.

On the West coast of England, they have plenty of coal near them from their own mines, that will only cost them, coked, about nine shillings per ton; still they prefer paying from seventeen [17] to twenty [20] shillings per ton for Durham, or New Castle coke.

Scotch coals contain from 0.65 per ct. to 2.50 per ct. sulphur, and as high as 14 per ct. ash.

English coal will contain from 0.50 per ct. to 2.50 per ct. sulphur, and from 8 per ct. to 10 per ct. ash. Staffordshire thick coal will contain as low as 0.50 per ct. sulphur. Lowmore coal but only from ten inches to twenty inches thick contains only 0.35 per ct. sulphur: (*This is a rare exception.*)

Welch coal is of all quality, containing from 0.50 per ct. to 3.00 per ct. sulphur, and sometimes as high as 12 per ct. ash. The best iron made in Great Britain is made with coke as fuel. Large quantities of the small coal is washed so as to get it free from all *or*, as much impurities as possible, before coking it.

More than one-half the Bessemer steel made in the United States to-day, is made from English pig iron reduced with coke, (*Anthracite pig will not suit.*)

LIMESTONE.

	No. 1.	No. 2.	No. 3.
Silicic Acid,	1.00	1.00	5.40
Sesquioxides of Alumnia and Iron,	6.80	1.00	2.00
Carbonate of Lime,	88.80	94.20	88.00
Carbonate of Magnesia,	1.20	0.76	1.51
Water,	1.80	2.90	2.90
	99.60	99.96	99.81

No. 1. The lower part of the Ferriferous limestone.
No. 2. The upper part " " "
No. 3. Blue limestone: (I suppose Putnam Hill.)

FIRE CLAY.

	No. 1.	No. 2.	No. 3.	No. 4.
Silicic Acid,	61.90	57.90	54.15	59.30
Alumnia with trace of Iron,	22.80	26.60	23.30	24.10
Lime,	0.05	0.25	1.25	0.80
Magnesia,	0.70	0.60	trace	1.15
Water,	12.90	13.00	10.30	13.25
Potash and Soda,	0.90	1.15	0.90	0.95
	96.25	99.50	99.90	99.55

I have seen first-class pneumatic steel made from pig iron reduced from raw material no better than such as Dr. Wolf's No. 1 coal, (*coked*) and the four samples of iron ore from the Buckeye furnace and No. 2 limestone. (*Why not then, make such here?*)

If we presume that only six miles of the land on each side of your Railroad will be tributary to your road, you will then have more superficial area of coal lands than the whole of the coal lands of the Kingdom of Belgium. Notwithstanding the Belgium coal mines yield annually, more than 11,000,000 tons of coal from veins that are only from thirty inches to three feet thick, three-fourths of which she consumes in home manufacturies exporting only about one-fourth of her production.

"One of the Western Virginia papers says that an acre of Kan-"awha land contains one million, seven hundred and fifty thou-"sand (1,750,000) bushels of coal, and is valued at less than one "hundred dollars ($100.00) per acre; and an acre of Pittsburg coal "land contains only one hundred and seventy-three thousand "(173,000) bushels, and is held at over one thousand dollars "($1,000.00) per acre."

This is a mistake, for Pittsburg coal lands contain over one million, one hundred and fifty thousand (1,150,000) bushels of coal to the acre.—[Dana's Geology, page 322.]

This, however, illustrates the value of coal lands that are well supplied with Railroad facilities, and within a short distance of the Western markets.

The coal of the Kanawha will only be able to use the Kanawha and Ohio rivers for carriers for its coal; therefore will never be able to compete with the coal of this region, that will have its market between here and Chicago.

It is senseless arrogance to say that coal mined on the Eastern out-crop of the great Appalachian coal field can possibly compete in Western markets with coal mined on the Western out-crop.

Therefore the ratio of increased value of Western coal lands in the United States is almost beyond human calculation.

In the older countries laws are enacted for the preservation of their forests; it will be but a short time before this will have to be done in this prolific land of coal.

The (*English Engineer,*) of July 26, 1867, says:

"The French Government, anxious to preserve their existing

woods, are doing all they can to induce English coal owners ot send coal into that country, &c."

What is the spectacle here?

The locomotives of the United States burn up sixty million dollars ($60,000,000.00) worth of wood annually. (Is it not easy to guess the climatic effect of this, if not checked within a short time.) Nine-tenths of this wood, we can safely say, is burnt West of the Allegheny Mountains; therefore, will be in the Western coal operators' market.

In 1854, England mined 64,600,000 tons of coal, and in sixteen years after, in the year 1871, she mined more than double that quantity; or, 112,875,725 tons.

In 1860, Germany mined 12,347,828 tons of coal, and in nine years, more than doubled her production; or, mined 26,774,288 tons of coal.

England's army of 350,000 coal miners gives her more real physical and moral strength, in the civilized world, than any army or navy she could possibly create.

Some writer said that a country's greatness is in proportion to her coal fields, and the use she makes of them. The United States coal fields are twelve times as large as those of the British Isles.

To give an idea of the rapid progress the coal trade is making, in the United States, I give the following from the pen of Benj. Bannan, Esq., Pottsville, Pa., than whom there is no better authority on coal statistics in the United States.

This will only be the amount of coal sent to market:

	Anthracite.	Bituminous.
In 1820	365 tons	"
" 1830	174,734 "	"
" 1840	841,584 "	tons
" 1850	2,287,970 "	196,848
" 1860	8,513,123 "	788,909
" 1870	15,274,029 "	1,717,085
" 1871	14,965,501 "	2,345,153

The cause of this decrease in the Anthracite coal trade was the result of disastrous strikes among the Anthracite coal miners.

Since 1850, the same authority gives the following as the amount of coal sold on the line of the Philadelphia and Reading Railroad, and its Lebanon branch:

			Total.
1850	166,992 tons per Rail	40,871 tons Canal	207,836
1860	385,860 " " "	223,017 " "	608,887
1870	1,072,400 " " "	116,549 " "	1,189,164
1871	1,128,227 " " "	94,813 " "	1,223,040

The increase, as Mr. Bannan says, is very small over the sup-

ply of 1870—only 33,876 tons. There were delivered at points where there were iron works on the line in—

1871.....918,165 tons.
1870.....860,320 "

1871. Increased consumption in iron works..... 58,845 tons.

To show the increase in part of the Eastern bituminous coal trade, Mr. Bannan says that *Blossburg*, *Towanda*, and McIntyre coal mines, sent to market the fellowing quantity of coal, as follows:

	Blossburg.	Towanda.	McIntyre.
1840	4,235 tons	"	"
1860	23,161 "	"	"
1856	70,669 "	2,295 tons	"
1860	76,918 "	27,718 "	"
1870	733,035 "	271,335 "	17,808 tons.
1871	815,079 "	378,335 "	106,130 "

"The following is the quantity of coal transported over the New Jersey Central Railroad in the following years:"

	Tons.
1856	131,994
1860	854,647
1870	2,052,184

Still the demand is increasing all over the world, in a ratio almost beyond any calculation. *Truly we are living in an oxidizing age.*

Schuylkill county, Pa., part of which is in the coal formation, had a population in 1830, of 20,744; in 1840, 60,715; in 1860, 89,528; and in 1870, 116,428. All this increase of population is attributable to the coal mines only.

For more information on the coal statistics of the United States, I would refer the reader to Mr. Bannan's pamphlet called Coal Statistical Register, published at the Miner's Journal office, Pottsville, Pa.

Coal land owners, operators, miners, and all interested in coal lands, or coal mining, should have this cheap and useful little book.

Great as has been the increased consumption of coal for the last fifty years, it will have no comparison with what the increase will be, even the next ten years, especially so in the Western markets.

The last fifty years' increase and consumption has been East of the Allegheny Mountains to a far greater degree than West.

The great demand West for a smokeless and cheap fuel, will open to the bituminous coal operator a field of business in the production of coke, from slack coal of the mines, that will yield him a profit greatly in excess of that on lump coal.

Anthracite coal is worth to-day, in Toledo, not less than $8.58 per ton; Chicago, $12 per ton., and in other cities West and North-

west, in proportion to the freight upon it. This Anthracite coal, that has to cross the Allegheny Mountains, is the only coal or fuel that will compete with the coke of this region, and it ought to be understood that all the sulphur in the form of bisulphide of iron, or any other form the sulphur may take, that will make a difference in its specific gravity, and that of the coal, and all other impurities not having the same specific gravity as coal, can be washed out of the coal in a *water jigging machine*. Hence, it will be readily understood that a coke can be made from this coal slack that will be almost free from all impurities, or a pure carbon fuel.

No patents can be got on such a machine, for they have been in use, that I know of, for the last fifteen or eighteen years, probably more than that.

A Pittsburg paper says:—

"At the Keystone mines, on the Monongahela River, between "four and five acres of coal land, containing a vein of from sixty "to sixty-two inches, is mined monthly. The slack from this coal "is coked in the companies' ovens, and shipped to Chicago in cars "that come East with cattle, at the rate of 1,000 bushels a day. "Ovens are being put up to double the production of coke for Western markets."

Again, the *Protectionist* says:—

"The enormous piles of slack, or waste coal, laying contiguous "to the Westmoreland Coal Companies' mines are to be utilized at "last, and turned into coke. The Messrs. Carnegie, of Pittsburg, "and others, are constructing coke ovens along the Pennsylvania "R. R. for this purpose, and it is said they will be successful. Having a process for desulphurizing the fine coal. The sulphur has "heretofore prevented coke being made from Westmoreland coal. "There are upwards of 900 coke ovens along the Pittsburg and "Connellsville road, and the Uniontown and Bradford, and Mount "Pleasant Branch roads, and 400 additional ones are being con-"structed. Some idea of the tonage can be formed when it is "known that the production largely exceed 100,000 bushels, or "about 5,000 tons of coke per day, and falls far short of the demand "in Western markets."

It would be well for me to say that beside your connection at, or near McArthur Station, with the Marietta and Cincinnati Railroad, and at Logan with the Columbus and Hocking Valley Railroad, you will have a connection with the Farmers' and Miners' Railroad [as shown on Railroad Map] at, or near McArthur, which will be a very important outlet for your mineral, and equally as important an inlet for the agricultural products of Pickaway, Madison, Ross and Champaign counties, and, indeed, from the whole Northwest. The Farmers' and Miners' Railroad has live men at the head of it, and they are pushing it forward with energy, and expect to have it finished to McArthur by the time you are ready to meet them there. They will come loaded with produce for the dense population that you must have along the line of your road as soon as the mineral on your route commences to be

developed, and they will return with their trains loaded with coal and other minerals.

In addition to this, there is a fair prospect of your getting a connection with the Dayton and Southeastern Railroad, *via.* Xenia and Washington, Fayette county, which will also bring in produce and take back coal and other minerals, never needing to have an empty car, either way, for want of freight.

I am yours respectfully,

WILLIAM GRIFFITH, Jr.

GALLIPOLIS, Ohio, April, 1872.

RUNYAN, Printer, Gallipolis.

Scale for group on this side
1/4 in. to the foot

GEOLOGICAL CROSS SECTIONS
OF THE MINERAL STRATA
ON THE LINE OF THE
GALLIPOLIS, McARTHUR,
AND
COLUMBUS RAILROAD.

EXPLANATION.

A—Cross Section constructed from No. 2, Sec. of the Geological Survey, page 243, showing the strata between Sec. 7, Washington Twp., Jackson Co., and Wilkesville, Vinton Co., with intervening veins, as shown on General Section of the lower Coal measures, Sec. 1, Page 243.

B—Section on Sec. 22, Elk Twp., Vinton Co., from Crop indications, etc.
C—Section on Sec. 33, Vinton Twp., Vinton Co. from Crop indications, etc.
D—Section on Sec. 29, Wilkes Twp., Vinton Co. (Salt well bore,) and Crops.
E—Section on Sec. 35, Wilkes Twp., Vinton Co., Crop indications, etc.
F—Section on Keystone lands, Bloomfield Twp., Jackson Co.
G—Sec. under Coal No. 13, Map 5, No. 22, Geological Survey.
H—Sec. of Coal vein No. 2, Map 3, No. 18, " "
I—Sec. of Coal vein No. 1, Map 3, No. 16, " "
J—Sec. of Coal veins Nos. 7, 8 and 9, boring on Raccoon.
X—Railroad level at Section J on Raccoon, showing its position with regard to high water and coal vein.

K—Coal vein Sec. 30, Elk Twp., Vinton Co., Map 2, No. 8.
L—Coal vein Section 14, Elk Twp., Vinton Co., Map 2, No. 10 Geological Survey.
M—Section on Sec. 24, Wilkes Twp., Vinton Co.
N—Section on Sec. 22, Elk Twp., Vinton Co.
O—Section on Eagle Furnace lands, Vinton Co.
P—Coal vein on Sec. 17, Elk Twp., Vinton Co.
Q—Section on Raccoon.
R—Coal vein No. 10, Sec. 35, Wilkes Twp., Vinton Co.
S—Coal vein No. 12, Sec. 29, " " "
T—Coal vein No. 12, Sec. 19, Walnut Twp., Gallia Co.
U—Coal vein No. 9, Sec. 24, Wilkes Twp. Vinton Co.

u w—Upper Waverly.
L No. 1—Maxville Limestone.
a—Iron Ore.
1—Jackson Shaft Coal.
2—Anthony Coal.
3—Thompson Coal, (undeveloped).
b—Iron Ore.
4—Jackson Hill Coal.
5—Coal called No. 10, (undeveloped.)
c—Iron Ore.
6—Flint Ridge Coal, (undeveloped).
L No. 2—Putnam Hill Limestone.
d—Iron Ore.
e—Iron Ore.

7—Coal 11 ft. at Hawks, on Raccoon.
f—Iron Ore.
8—New Lexington Coal, at Hawks, in Creek.
g—Iron Ore.
9—Limestone vein of Coal.
L No. 3—Ferriferous Limestone.
h—Limestone Ore.
+ Flint.
10—New Castle Coal.
i—Iron Ore.
11—Norris Coal, (undeveloped).
12—Sheridan Coal.
j—Iron Ore.

L No. 4—Buff Limestone.
13—Stallsmith, or Keystone Coal.
L No. 5—Sandy Limestone.
k—Iron Ore.
14—Hatcher Coal.
15—Wilkesville Coal.
16—Wilkesville Upper Coal.
l—Iron Ore.
m—Iron Ore.
n—Iron Ore.
L No. 6—Fossiliferous Limestone.
U C—Uppper Conglomerate, and 50 feet above comes White Limestone and Greasy Ridge Coal.

WM. GRIFFITH, JR.
GALLIPOLIS, OHIO.

February, 1872.

Scale for group on this side
1/4 in. to the foot

Wm. GRIFFITH, JUN.R GALLIPOLIS, FEBY. 1872.
STRABRIDGE & CO. LITH. CINCINNATI, O.

GEOLOGICAL CROSS SECTION ON RACCOON

SEC. 27 WILKSVILLE TWP. VINTON CO. OHIO,

SHOWING THE MINERAL STRATA ON THE LINE OF THE

GALLIPOLIS, Mc ARTHUR AND COLUMBUS RAILROAD.

CONFIRMED BY STATE GEOLOGICAL SURVEY 1870 PAGE 243.

EXPLANATION.

u w—Upper Waverly.
L No. 1—Maxville Limestone.
a— Lower Iron Ore.
1—Jackson Shaft Coal.
2—Anthony Coal.
3—Thompson Coal, (undeveloped).
b—Iron Ore.
4—Jackson Hill Coal.
5—Coal called No. 10, (undeveloped).
c—Iron Ore.

6—Flint Ridge Coal, (undeveloped).
L No. 2—Putnam Hill Limestone.
d s e Iron Ore. veins
7—Coal 11 ft. (as shown on Raccoon.)
f—Iron Ore.
8—New Lexington Coal, (in Creek as shown)
g—Iron Ore.
9—Limestone vein of Coal.
L No. 3—Ferriferous Limestone.
h i x Limestone Ore. & Flint *x*.

10 E[d] Simmon's Coal on Raccoon (New Castle Coal.)
i—Iron Ore.
11—Norris Coal, (undeveloped).
12—Lawler Coal on Raccoon (Sheridan Coal.)
j—Iron Ore.
L No. 4—Buff Limestone.
k—Iron Ore.
13—Stallsmith, or Keystone Coal.
L No. 5—Sandy Limestone.
l—Iron Ore.

14—Hatcher Coal. (undeveloped)
15—Wilkesville lower Coal.
16—Wilkesville Upper Coal.
m & n. Latta Iron Ore.
L No. 6—Fossiliferous Limestone.
R Gallipolis Mc Arthur & Columbus Railroad.
W Salt Well on Raccoon through 11 Ft Coal № 7.
z. Raccoon Creek

STATE GEOLOGIST'S COLOUM.

STRODRIDGE & CO. LITH. CINCINNATI, O.
Wm GRIFFITH JUN[r] GALLIPOLIS, OHIO, MARCH 1870.